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mall-Scale Trials of Five Insecticides . . .

sprayed on spruce budworm in Montana

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ABSTRACT: Five insecticides were field-tested against the spruce budworm (*Choristoneura occidentalis* Freeman) in Montana in 1966. They were sprayed by helicopters on 40-acre plots. Low-volume Zectran was as effective as malathion LVC and DDT. Similar results were obtained with SD-8530 formulations with and without synergist. Spray droplet density was over twice as great on the SD-8530-plus synergist plot than it was on the SD-8530-without-synergist plot.

RETRIEVAL TERMS: insecticide; pesticide; chemical control; carbamate; DDT; malathion; pyrethrin; synergist; *Choristoneura occidentalis;* Montana.

OXFORD: 145.718.28 *Choristoneura occidentalis* + 453--145.718.28 *Choristoneura occidentalis* + 414.

In July 1966, the U.S. Forest Service tested five insecticides on the spruce budworm (*Choristoneura occidentalis* Freeman) in Montana. These small-scale tests were part of an over-all program to find non-persistent chemical treatments that will show selectivity for specific forest insect pests.[1] Such field tests are employed to obtain a measure of the relative effectiveness of different treatments on the target insect under field conditions. This procedure reduces some of the uncertainty involved in selecting materials for large-scale testing.

The aim of the tests reported in this note was to check the following hypotheses that were developed from other studies conducted by the U.S. Forest Service's Insecticide Evaluation Research Program:

1. That a low-volume concentrate Zectran[2] (4-dimethylamino-3, 5-xylyl methylcarbamate) treatment at the rate of 0.15 lb. (in 13 fl. oz.)/acre would give results (in terms of initial reduction in budworm population) comparable to a low-volume malathion treatment at the rate of 1.0 lb. (13 fl. oz.)/acre and to a standard DDT treatment at the rate of 1.0 lb./gal./acre.

2. That by adding the synergist sulfoxide[3] to the carbamate SD-8530[4] (3,4, 5-trimethylphenyl methylcarbamate) in a 1:1 ratio, the amount of active SD-8530 could be reduced by one-half.

3. That the addition of a specific stabilizer[5] to a pyrethrins formulation would increase the effectiveness of the treatment against spruce budworm.

Methods

Seven 40-acre plots were selected in areas with moderate to heavy spruce budworm populations. Each plot was 720 by 2,420 ft. Fluorescent plastic panels were placed near each plot corner to orient the spray pilot. In each plot, 20 full crowned, codominant Douglas-fir trees were chosen and marked. A prespray sample consisting of six 15-inch branch tips was cut the

[1] U.S. Forest Service. *Evaluation of chemicals for control of forest insects.* Pacific SW. Forest & Range Exp. Sta., Berkeley, Calif. 8 pp., illus. 1965.

[2] A product of the Dow Chemical Company. Trade names and commercial enterprises or products are mentioned solely for necessary information. No endorsement by the U.S. Department of Agriculture is implied.

[3] Produced by the Farm Chemical and Insecticide Division, S.B. Penick and Co., New York, N.Y.

[4] Produced by the Shell Chemical Company.

[5] Developed by R. P. Miskus and T. Andrews. Patent pending.

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Table 1.--*Treatments made during 1966 small-scale field tests in Montana*

Insecticide	Additives	Solvent	Rate per acre
Pyrethrins	None	Bayol (Isopar M)[1]	0.1 lb. in 1 gal.
Pyrethrins	Stabilizer	Bayol (Isopar M)[1]	0.1 lb. in 1 gal.
SD-8530	None	Mixture of aromatic oils[2]	0.5 lb. in 1 gal.
SD-8530	0.25 lb. sulfoxide/gal.[3]	Mixture of aromatic oils[2]	0.25 lb. in 1 gal.
DDT	None	Methylene chloride and #2 diesel oil	1.0 lb. in 1 gal.
Malathion	None	None	1.0 lb. in 13 fl. oz.
Zectran	None	Dowanol DB[4]	0.15 lb. in 13 fl. oz.

[1]Humble Oil and Refining Company.

[2]Shell Chemical Company.

[3]Farm Chemical and Insecticide Division, S.B. Penick and Co., New York, New York.

[4]Dow Chemical Company.

day before spraying from the midcrown of each tree by using an aluminum pole pruner with basket attachment. Samples were placed in polyethylene bags and transported to a field laboratory where they were examined. Number of budworms, their stage of development, number of buds, and foliage area were recorded for each branch.

Immediately before spraying, oil-sensitive spray deposit cards were distributed around each tree to assess the spraying. Four cards--one each at the uphill, two sidehill, and downhill locations--were placed in openings around each tree. Preliminary laboratory tests indicated that Bayol (Isopar M, Humble Oil Co.) did not spot well on the cards, so a solid fluorescent tracer of zinc-cadmium sulfide particles was used for assessment of the pyrethrins sprays.[6]

All insecticides were applied by a Bell G-3B helicopter, flying at 45 to 50 m.p.h. and about 50 ft. above the treetops (table 1). A conventional boom system was used for all tests with 31 #80015 nozzles[7] for 1-gal./acre tests and 6 #8001 nozzles (Spraying Systems Co., Bellwood, Ill.) for low volume tests. A 45-ft. swath width and 15 to 21 swaths were used per plot to allow for ample atmospheric mixing of the spray. Plots were sprayed over a period between 5 and 9 a.m. each day.

Wind was calm at time of sprayings on all areas except on the plots on which the Zectran and pyrethrins without stabilizer were tested. Wind speed was 5 to 10 m.p.h. on the Zectran plot and 2 to 6 m.p.h. on the pyrethrins-without-stabilizer plot. Temperatures at time of application were below 65° on all but the pyrethrins-without-stabilizer plot, where it was 70 to 75°F.

Budworm development was well advanced at treatment time (table 2). Most of the larvae were in the 5th and 6th instars, and some pupation had occurred.

Spray assessment cards were collected within 45 minutes after spraying and wrapped in aluminum foil. Spray density was estimated by counting all droplets within the center square inch of each card. All cards except those sprayed by pyrethrins were examined under incandescent light with the aid of a microscope at 30X. The pyrethrins-sprayed cards were examined under ultraviolet light at 20X.

Postspray foliage samples consisting of eight 15-inch branch tips per tree were collected 10 days after spraying.

[6]Himel, C.M., Vaughn, L., Miskus, R.P., and Moore, A.D. *A new method for spray deposit assessment*. U.S. Forest Serv. Res. Note PSW-87, 10 pp., illus. Pacific SW. Forest & Range Exp. Sta., Berkeley, Calif. 1965.

[7]Duncan, D.B. *Multiple range and multiple F tests*. Biometrics 11:1-42. 1955.

Table 2.--*Spruce budworm development 1 day before spraying*

Treatment of plot	Budworms	Instar			Pupae	Total
		4th	5th	6th		
	No.	*Percent*				
Pyrethrins	1,107	5.4	39.9	54.0	0.7	100
Pyrethrins + stabilizer	1,153	15.2	26.5	58.2	.1	100
SD-8530 + synergist	778	18.8	43.7	37.5	.0	100
SD-8530	1,040	11.9	42.3	45.4	.4	100
DDT	666	6.9	27.6	65.3	.2	100
Malathion LVC	861	7.2	52.0	40.1	.7	100
Zectran LV	633	1.0	28.9	68.2	1.9	100
Combined	6,238	9.92	37.55	52.02	.51	100

Larval mortality figures were calculated using the ratio estimate methods.

Results and Discussion

The results suggested that hypothesis No. 1 was correct (table 3). Duncan's[7] multiple range test gave similar results for Zectran, malathion, and DDT.

Both SD-8530 treatments yielded similar mortality, indicating that hypothesis No. 2 also was correct. However the high droplet count for the SD-8530-plus-synergist treatment throws doubt on the validity of this test. Detectable spray deposit on this plot was uniformly high, ranging from 291 to 574 droplets per sq. in., with larval mortality

Table 3.--*Summary of results of 1966 small-scale field test in Montana*

Treatment	Larval mortality			Droplet density		Droplet D-max	Correlation coefficient droplet density/ larval mortality
	Range	Avg. 1/	S.E.	Avg.	S.E.		
	Percent			*Number/sq. in.*		*Microns*	
Zectran LV	85-100	94.4	1.29	16.4	1.63	418	2/ .44*
Malathion LVC	66-100	90.4	2.39	73.4	4.29	382	.58**
DDT	10-100	87.7	2.93	106.3	9.08	495	.47*
SD-8530 + synergist	50-100	82.2	3.95	397.5	12.42	518	.23
SD-8530	39- 99	82.1	2.41	146.6	16.48	470	.74**
Pyrethrins + stabilizer	0- 98	73.0	3.06	164.3	9.77	420	.39
Pyrethrins	35- 81	65.2	2.80	117.6	5.85	440	.11

[1]Brackets indicate comparisons according to Duncan's multiple range test at 95 percent significance level. (Duncan, D.B. *Multiple range and multiple F tests.* [2]Biometrics 11:1-42. 1955.)

* = significant at p = .05. ** = significant at p = .01.

ranging between 56 to 100 percent. On the SD-8530-without-synergist plot, the average deposit was below 50 droplets per sq. in. on 9 of 20 trees. Eight of these nine trees were on one end of the plot and were probably missed directly by the spray plane. Mortality ranged from 39-85 percent on these 9 trees and from 81-99 percent on the remaining 11 trees; spray deposit ranged from 139-425 droplets per sq. in. on the 11 trees. Mortality was not related to spray droplet density on the SD-8530-with-synergist plot, but the relationship was highly significant on the SD-8530-without-synergist plot (table 3). Hypothesis No. 2 probably will have to be retested to determine its correctness.

Results with the pyrethrins sprays indicated that the particular stabilizer tested did not increase effectiveness against spruce budworm. Work on pyrethrins stabilization following the field tests indicated that one of the constituents of both formulations produced breakdown of the active materials. This constituent has since been replaced by a more satisfactory material.

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